

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : E21B 43/30		A1	(11) International Publication Number: WO 99/60248 (43) International Publication Date: 25 November 1999 (25.11.99)
(21) International Application Number: PCT/GB99/01593		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 19 May 1999 (19.05.99)		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(30) Priority Data: 9810722.0 20 May 1998 (20.05.98) GB			
(71)(72) Applicant and Inventor: JOHNSTON, Sidney, Dantuma [GB/GB]; 23 Duthie Terrace, Mannochfield, Aberdeen AB10 7PP (GB).			
(74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QT (GB).			
(54) Title: METHOD OF PRODUCING FLUIDS FROM AN UNDERGROUND RESERVOIR			
(57) Abstract			
<p>A method is disclosed for producing fluids such as oil and gas from a wellbore, typically a subsea wellbore. The method comprises linking first and second wellbores to enable reservoir fluids located in a reservoir into which the second wellbore passes to reach both wellbores in order to avoid the need for surface pipelines linking the two wells.</p>			

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

1 METHOD OF PRODUCING FLUIDS FROM AN UNDERGROUND RESERVOIR

2 The present invention relates to a method of producing
3 fluids from underground reservoirs, and particularly
4 relates to using first and second wellbores to link
5 such reservoirs to a production facility.
6

7 Hydrocarbon reservoirs of oil and gas which are located
8 too far from existing or proposed hydrocarbon
9 production facilities are typically developed by
10 drilling wells from directly above those reservoirs,
11 and then providing a pipeline from the wellhead to the
12 production facility.
13

14 According to the invention there is provided a method
15 of producing fluids from underground reservoirs, the
16 method comprising drilling a first wellbore, drilling a
17 second wellbore into the reservoir, and linking the two
18 wellbores to allow fluids to flow from the reservoir to
19 the first wellbore.
20

21 Preferably the reservoir is an oil or gas well
22 reservoir, and most preferably an offshore reservoir.
23

24 The first wellbore is typically at least partially
25

1 deviated, so that it extends from a site of a
2 production platform (or similar facility) laterally
3 towards the reservoir for the maximum distance feasible
4 for horizontal or lateral drilling.

5

6 The second wellbore can optionally be drilled
7 subsequently so as to pass through (or close to) the
8 end of the first wellbore and can be vertical or
9 deviated as required to connect the reservoir to the
10 first wellbore.

11

12 The first and second wellbores can be linked by a
13 number of means. For example, the second wellbore can
14 simply pass through the first wellbore, and can be
15 plugged between the junction with the first wellbore
16 and the surface, so that fluids passing through the
17 second wellbore from the reservoir are diverted only
18 into the first wellbore. Alternatively, the first and
19 second wellbores can be linked by a further wellbore
20 drilled before or after the second wellbore, or a
21 series of such further bores, so that the fluids can
22 travel from the reservoir to the first bore through a
23 series of interconnected bores. The first and second
24 (and/or the further) bores can be drilled so as to be
25 separated from one another by a portion of the medium
26 through which they are drilled (ie they can pass close
27 to the ends of the previous bore but not connected
28 thereto to allow fluid flow) and can be linked
29 subsequently by controlled explosion at the ends of the
30 bores, by perforation by some other means, by
31 fracturing, by stimulation, or by drilling etc.
32 Indeed, in one embodiment of the invention it is an
33 option to generate an explosion at the end of the first
34 (or subsequent further) bore in order to create a
35 chamber of a size large enough to facilitate drilling
36 into the chamber when the subsequent wellbore is

1 drilled. Alternatively, where the formation permits,
2 first or subsequent further wellbores can be drilled
3 deliberately into naturally occurring voids (ie
4 formations capable of permitting fluid flow through
5 such formations), so as to allow easy interconnection
6 of the chain of wellbores.

7
8 One advantage of the invention is that pipelines
9 necessary to connect remote wellheads to production
10 facilities can be avoided and this avoids expense in
11 constructing, maintaining, operating and inspecting the
12 pipeline and associated injection pipelines and control
13 umbilicals etc. In addition to cost benefits, the
14 invention allows a decrease in the hydrocarbon-bearing
15 installations above land or above the seabed, thereby
16 reducing potential environmental and safety impacts.

17
18 This invention is therefore particularly applicable in
19 environmentally sensitive areas such as Alaska.

20
21 An embodiment of the present invention will now be
22 described with reference to the accompanying drawings
23 in which:

24
25 Fig. 1 is a schematic representation of a system of
26 wells drilled according to the present invention;
27 and
28 Fig. 2 is a schematic representation of a system
29 of wells drilled according to a second embodiment.

30
31 Referring now to the drawings, Fig. 1 shows a fixed
32 drilling/production platform P having a vertical well
33 connecting the platform to two hydrocarbon reservoirs
34 R1, R2 directly below the platform P. The platform P
35 is also drilling, by conventional, known means, a
36 laterally deviated well W1 in the direction of a third

1 hydrocarbon reservoir R3 laterally displaced from the
2 production platform P. When the limit of horizontal
3 drilling of well W1 is reached, a second well W2 is
4 drilled from a semi-submersible (or fixed jacket or any
5 other drilling facility) drilling platform D1 downwards
6 from the platform D1 in the direction of the end point
7 of well W1. W2 can be drilled straight through a
8 portion of W1, for example at the end thereof, or can
9 be drilled so as to pass close to the end of W1, but
10 not to intersect with it to allow fluid flow between W2
11 and W1. In the embodiment shown in Fig. 1, the well W2
12 has been drilled to intersect with W1 and allow fluid
13 transfer between the wellbores.

14 After intersecting or passing close to W1, the second
15 well W2 is drilled laterally as W2L towards the third
16 hydrocarbon reservoir R3. When W2L reaches the
17 formation of hydrocarbon reservoir R3, the drilling
18 string extracted and the wells completed, a plug P5 can
19 be inserted in W2 between the junction with W1 and the
20 platform D1 so as to divert fluids flowing from
21 reservoir R3 into W1 and therefore to the production
22 platform P. The platform D1 is then no longer
23 required.

24 The junction between W2 and W1 (Detail A) can be made
25 during drilling by accurately drilling W2 into W1 using
26 directional drilling techniques. W2 can be drilled
27 subsequently to W1, or vice versa. Alternatively, W1
28 can be drilled into an existing and depleted
29 hydrocarbon reservoir or other naturally occurring void
30 from a lateral side thereof, and W2 can subsequently be
31 drilled into the same depleted reservoir and on through
32 it into reservoir R3. As a further alternative, the
33 two wells can be drilled so as not to intersect but to
34 pass within a short distance (eg a few metres) of one

1 another allowing perforation of the separation by eg
2 explosives etc. at a later date when drilling has been
3 completed. It can be seen from this embodiment that
4 the order of drilling W1 and W2 does not matter.

5
6 Fig. 2 shows a further embodiment of the invention
7 similar to that shown in Fig. 1, except that W2L is
8 drilled into a natural occurring cavity (Detail B) at
9 the limit of horizontal drilling of W2L. A third well
10 W3 is drilled (before or after W1 and W2) to intersect
11 with cavity (Detail B), and to extend thereto to
12 reservoir R4. As in the first embodiment, a plug P5
13 can be installed upon completion of W3 to divert fluids
14 from R4 into W2L and from there into W1. As before,
15 the manner and timing of linkage from W3 to W2L is a
16 matter of choice, and can be by eg explosives etc.

17
18 According to the invention, any number of wells can be
19 linked together in order to tie distant reservoirs to
20 existing or proposed platforms by boreholes rather than
21 by pipelines. The same drill ship or platform D1 can
22 be used to drill the second and further wells linking
23 the first wellbore to the reservoir, and more than one
24 wellbore can be drilled from any one drill ship so as
25 to allow several branches leading back to the same
26 first or subsequent lateral well, as shown in the
27 dotted lines of wells W5 and W6 connecting reservoirs
28 R5 and R6 respectively to the cavity at Detail B.
29 Although described with specific examples relating to
30 offshore drilling facilities, the invention is also
31 applicable to onshore wells, and the drill
32 ships/offshore platforms described in the examples can
33 be replaced by onshore equivalents well known in the
34 art.

35
36 The wellbore sizes can be varied according to

1 production requirements. 2
2
3 Should pigging facilities, chemical injection
4 facilities etc be required then the design of the
5 wellbores can be altered to facilitate the
6 incorporation of such facilities eg subsurface pigging
7 facilities from W2 to W1 and to platform P.

9 Modifications and improvements can be incorporated
10 without departing from the scope of the invention. For
11 example, although described with regard to hydrocarbon
12 reservoirs of oil and/or gas, the invention is
13 applicable to water and gas injection wells, and to
14 wells for the production and recovery of other liquids
15 gases, or slurries.

1 **Claims**

2

3 1 A method of producing fluids from an underground
4 reservoir, the method comprising drilling a first
5 wellbore, drilling a second wellbore into the
6 reservoir, and linking the two wellbores to allow
7 fluids to flow from the reservoir to the first
8 wellbore.

9

10 2 A method as claimed in claim 1, wherein the first
11 wellbore is deviated.

12

13 3 A method as claimed in claim 1 or claim 2, wherein
14 the wellbores are linked by drilling.

15 4 A method as claimed in any preceding claim,
16 wherein the reservoir is of oil or gas.

17 5 A method as claimed in any preceding claim,
18 wherein the wellbores are offshore or onshore
19 wellbores.

20 6 A method as claimed in any preceding claim,
21 wherein the first wellbore extends from a site of a
22 production platform towards the reservoir for the
23 maximum distance feasible for lateral drilling.

24 7 A method as claimed in any preceding claim,
25 wherein the second wellbore is drilled after the first
26 wellbore.

27 8 A method as claimed in any preceding claim,
28 wherein the second wellbore passes through or close to
29 the end of the first wellbore.

30 9 A method as claimed in any preceding claim,

1 wherein the second wellbore is deviated.

2

3 10 A method as claimed in any preceding claim,
4 wherein the second wellbore passes through or close to
5 the first wellbore.

6

7 11 A method as claimed in any one of claims 1-9,
8 wherein the first and second bores are drilled so as to
9 be separated from one another by a portion of the
10 medium through which they are drilled and are linked
11 subsequently by removal of the separating portion.

12

13 12 A method as claimed in claim 11, wherein the
14 separating portion is removed by perforation,
15 explosion, fracturing, stimulation or by drilling.

16

17 13 A method as claimed in any preceding claim,
18 wherein an explosion is detonated at the end of a bore
19 in order to create a chamber into which the successive
20 bore can be drilled.

21

22 14 A method as claimed in any preceding claim,
23 wherein a bore is drilled into naturally occurring
24 voids in the medium, into which a successive bore is
25 drilled.

26

27 15 A method as claimed in any preceding claim,
28 wherein after the two bores are linked the second
29 wellbore is plugged between the junction with the first
30 wellbore and the surface so that fluids passing through
31 the second wellbore from the reservoir are diverted
32 into the first wellbore.

33

34 16 A method as claimed in any preceding claim,
35 wherein the first and second wellbores are linked by
36 one or more further wellbore(s) drilled before or after

1 the second wellbore.

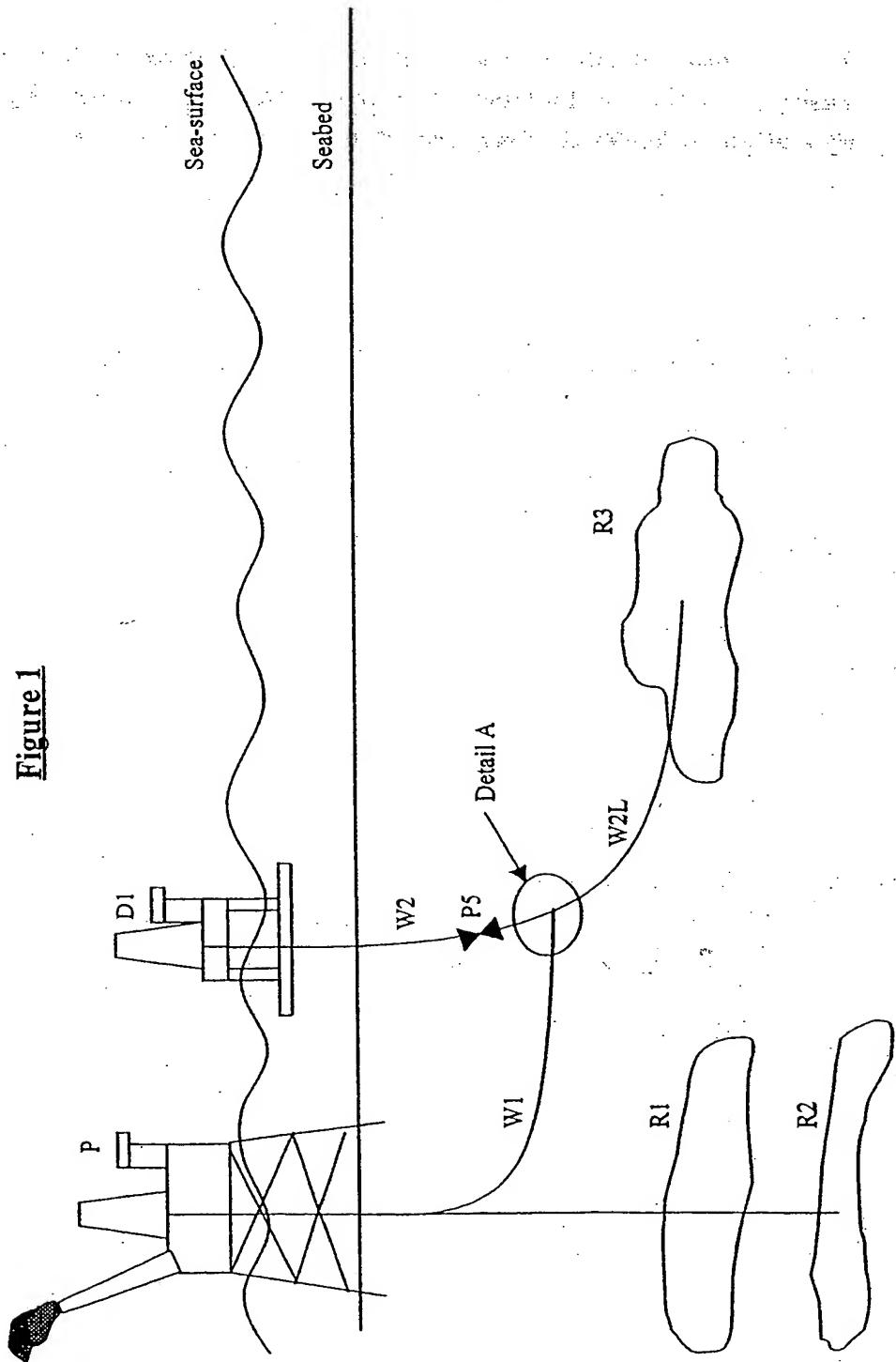
2

3 17 A method as claimed in claim 16, wherein the
4 reservoir(s) is linked to a production platform by
5 means of a linked chain of connected wellbores.

6

112

Figure 1



2 / 2

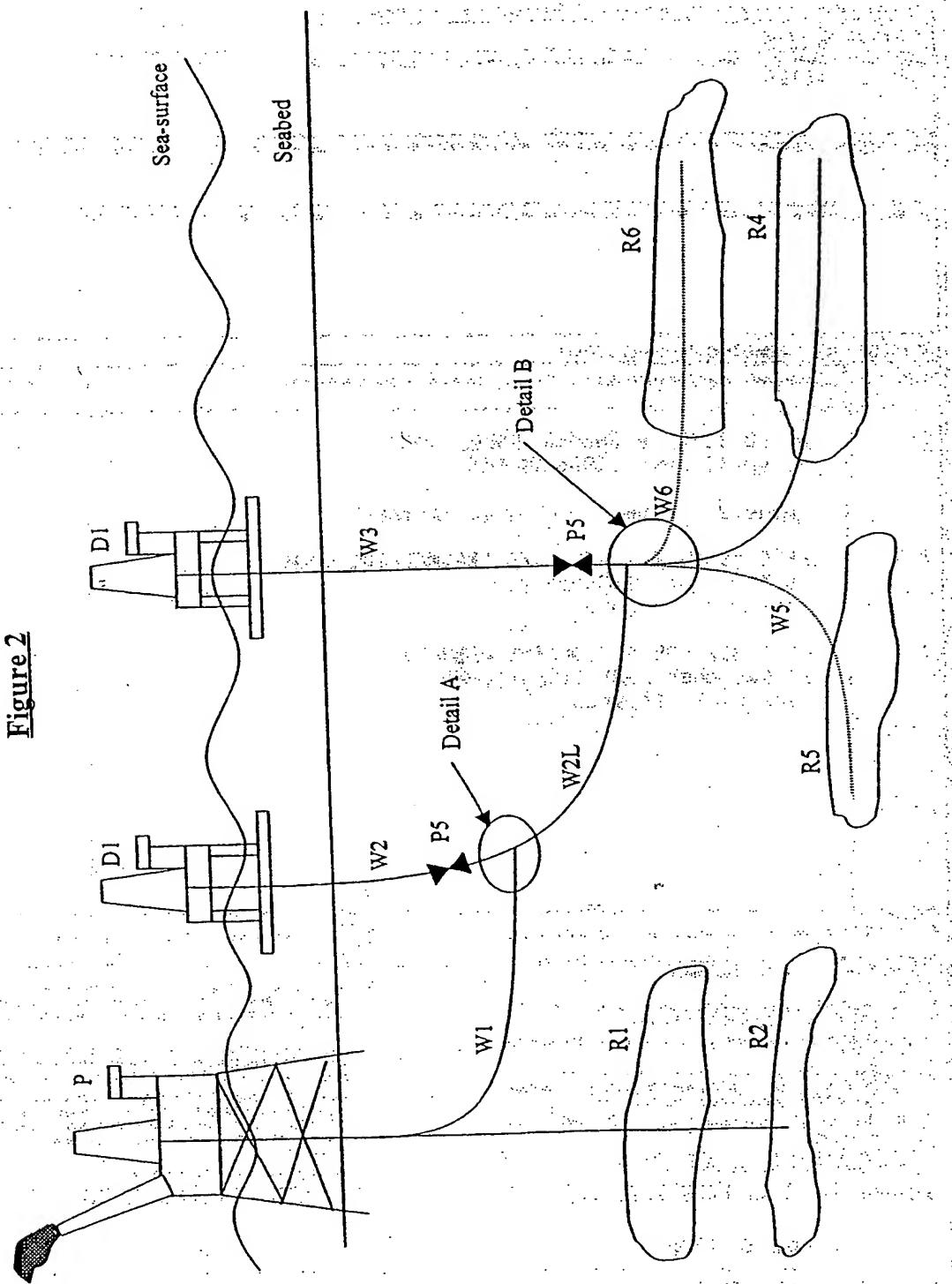


Figure 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/01593

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E21B43/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 15712 A (BAKER HUGHES INC) 16 April 1998 (1998-04-16) page 27, line 5 – line 9; figure 5	1-5, 8-12,15, 16
A	EP 0 598 316 A (IEG IND ENGINEERING GMBH) 25 May 1994 (1994-05-25) abstract; figures	1
X	US 4 422 505 A (COLLINS KENNETH L) 27 December 1983 (1983-12-27) abstract; figures	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

8 September 1999

Date of mailing of the international search report

16/09/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patenlaan 2
NL – 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Wei and, T

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/01593

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9815712 A	16-04-1998	AU	4819797 A	05-05-1998
EP 0598316 A	25-05-1994	DE	4238969 A	26-05-1994
		US	5468097 A	21-11-1995
US 4422505 A	27-12-1983	NONE		

